



# VIRGINIA SPACE GRANT CONSORTIUM

Old Dominion University  
Peninsula Center  
2713-D Magruder Boulevard  
Hampton, VA 23666  
(757) 865-0726  
FAX (757) 865-7965  
vsgc@pen.k12.va.us  
<http://www.vsgc.odu.edu>

January 26, 2001

## Member Institutions:

College of  
William and Mary

Hampton University

Old Dominion University

University of Virginia

Virginia Polytechnic  
Institute and State  
University

Mathematics and Science  
Center

Science Museum of  
Virginia

Virginia Air and Space  
Center

NASA Langley Research  
Center

State Council of Higher  
Education for Virginia

Virginia Community  
College System

Virginia Department of  
Education

Virginia's Center for  
Innovative Technology

To: Hank Jarrett, NASA Langley Research Center, Mail Stop 264  
Tim Warner, NASA Langley Research Center, mail Stop 264  
Mary Coburn, NASA Langley Research Center, Mail Stop 126  
NASA Center for AeroSpace Information (CASI), Parkway Center,  
7121 Standard Drive, Hanover, MD 21076-1320

From: Mary Sandy, Director *Mary Sandy*

Subject: Final Report for NASA Langley Research Center Grant #  
NAG1-2315

Attached is the final report with attachments as noted for NASA Langley Research Center Grant # NAG1-2315, a grant to the Virginia Space Grant Consortium to manage the National General Aviation Design Competition.

The complete financial report will be forwarded directly from Old Dominion Research Foundation.

Please contact me if there are any questions regarding this report.

cc: Kathy Olson, Old Dominion University Research Foundation  
VSGC Files

*GRANT / IN / 05*

**National General Aviation Design Competition**  
**Project Report**  
**October 1, 1999 – September 30, 2000**  
**NASA Langley Research Center Grant # NAG-1-2315**

Contact: Mary Sandy, Director  
Virginia Space Grant Consortium  
[Msandy@odu.edu](mailto:Msandy@odu.edu)/757-865-0726

This report summarizes the management of the National General Aviation Design Competition on behalf of NASA, the FAA and the Air Force by the Virginia Space Grant Consortium (VSGC) for the time period October 1, 1999 through September 30, 2000. This was the VSGC's sixth year of managing the Competition, which the Consortium originally designed, developed and implemented for NASA and the FAA. The seventh year of the Competition was announced in July 2000.

Awards to winning university teams were presented at a ceremony held at AirVenture 2000, the Experimental Aircraft Association's Annual Convention and Fly-In at Oshkosh, Wis. NASA, FAA and AOPA administrators presented the awards.

The competition calls for individuals or teams of undergraduate and graduate students from U.S. engineering schools to participate in a major national effort to rebuild the U.S. general aviation sector. For the purpose of the contest, general aviation aircraft are defined as fixed wing, single or dual engine (turbine or piston), single-pilot aircraft for 2-6 passengers. In addressing design challenges for a small aircraft transportation system, the competition seeks to raise student awareness of the importance of general aviation and to stimulate breakthroughs in technology and their application in the general aviation market. The Competition has two categories: Innovative Design, and Design It, Build It, Fly It. Awards were given in both categories for this reporting year. Sandy fielded approximately 20 inquiries from potential participants in the Competition.

### **Innovative Design Category**

National goals for revitalizing the industry offer excellent, open-ended design challenges with real world applications for the Innovative Design Category. Both individual and team submissions were encouraged. University faculty advisors and students consistently cite the value of this kind of educational experience for their engineering students. Nine design proposals from six universities were submitted for the 1999-2000 academic year competition for the Innovative Design Category. A review panel comprised of general aviation experts from FAA, EAA, NASA and industry reviewed the design packages and selected the awardees. Sixty-eight students participated in the Competition. Twelve of these students were female and fifty-six were male. There were also eleven faculty members. All winning teams presented their designs in NASA Technical Forums at the EAA's AirVenture 2000. The forums were coordinated and introduced by Mary Sandy, VSGC Director. Sandy wrote a press release

on the Competition winners and obtained graphic materials for the winning designs. These press materials were distributed nationally by NASA Langley and the universities of the winning student teams. She also coordinated with NASA to arrange for logistics and content of the award ceremony and the press activities at Oshkosh that related to the National General Aviation Design Competition. Sandy and VSGC administrative staff also made housing arrangements for the members of winning teams who attended the AirVenture ceremony and activities in Oshkosh, Wisconsin and arranged for travel stipends and award plaques and checks. The Virginia Space Grant Consortium also handled all logistical arrangements for AirVenture 2000 admissions, programs and parking.

**The first place award** was presented to a 28-student team from Virginia Polytechnic Institute and State University/Loughborough University, Blacksburg, VA and Leicestershire, United Kingdom. Virginia Tech/Loughborough's winning design was for the first successful roadable aircraft, the *Pegasus*, a general aviation airplane with all the capabilities of the best four-place, single engine aircraft and with the added utility of having the family car with you at any flight destination. Dr. James Marchman, Virginia Tech and Dr. Gart Page, Loughborough University, were the team's faculty advisors. The review panel of general aviation experts rated the design effort outstanding overall. The first place award provided a total of \$3,000 to design team members and a \$5,000 award to the university's Aerospace Engineering Department.

**Second place** honors went to Purdue University in West Lafayette, IN. for "Silairus 490", a six-passenger, piston engine aircraft that brings a new dimension of freedom to general aviation. Designed by a seven-student team, the "Silairus 490" offers the capacity of surface independent takeoff and landings to a wide range of customers, shortening door-to-door travel time. One of the goals of the proposed design is to shift personal travel from cars to general aviation aircraft, increasing the accessibility of off-airways communities, thus enhancing the demand for new small business and personal aircraft. The second place award provided a \$2,000 prize to the student team. Professor William A. Crossley was the team's faculty advisor.

The Purdue team also won the award for the **Best Use of Air-Force-Developed Technology Developed by the Air Force Research Laboratory**, for its incorporation of the ACLS developed by the United States Air Force. For this award, the team will share a \$3,000 prize from the Air Force.

**Third place** was awarded to Pennsylvania State University, University Park, PA. The team's design, called *Alnighter*, is a modern, composite general aviation aircraft. The six-place, single-engine, propeller-driven vehicle has a conventional layout. It features sophisticated aerodynamics and advanced systems and avionics. For third place, the ten-student team shared a \$1,000 prize. Penn State has the distinction of winning a place award in each year of the competition.

**The Best Retrofit Design Award** was presented to a four-student, University of Oklahoma, Norman, Okla., team for development of an innovative, multi-mode tuned

exhaust system which offers noise reduction while improving the airplane's performance. The design was undertaken as a part of a larger aircraft design project to show how an older aircraft can be retrofitted with more modern technologies for increased performance and safety. The award's sponsor -- the Aircraft Owners and Pilots Association Air Safety Foundation presented a \$500 award to the student team.

### **Design It, Build It, Fly It Category**

The University of Oklahoma won the competition for the **Design It, Build It, Fly It Award**. This award was made for their team's design of an energy-absorbing seat for the S28R Cougar. The award provided \$10,000 to the University of Oklahoma to take the team's highly innovative seat designs through a proof-of-concept phase. Over a period of two years, twenty-two aerospace and mechanical engineering students have been involved in the project. The purpose of the project is to demonstrate the suitability of these features for incorporation into general aviation aircraft, either in new design or through retrofit to the existing fleet. The energy absorbing seat design is part of the full aircraft development. The goal for the team's seat design is to create a lightweight, low cost, energy-absorbing, crashworthy seat that would meet the lumbar requirements of federal aviation regulations. The seat design will help dissipate excess energy and prevent lower back and peivic injuries. Two universities submitted proposals: Hampton University, Hampton, VA, with a seven-student team and the University of Oklahoma, Norman, OK, with a ten-student team.

### **2000-2001 Competition**

Guidelines for the 2000-2001 academic year were developed in consultation with Hank Jarrett, Deputy Director, NASA General Aviation Program Office, NASA Langley Research Center. Guidelines are posted on the VSGC Web Page at <http://www.vsgc.odu.edu> and are available for downloading. All specialized queries were forwarded to Hank Jarrett for his feedback prior to responding. One query from George Donahue at George Mason University resulted in NASA's approval of an on-line amendment to the Guidelines to include rotorcraft designs, though this occurred after the time frame for this project.

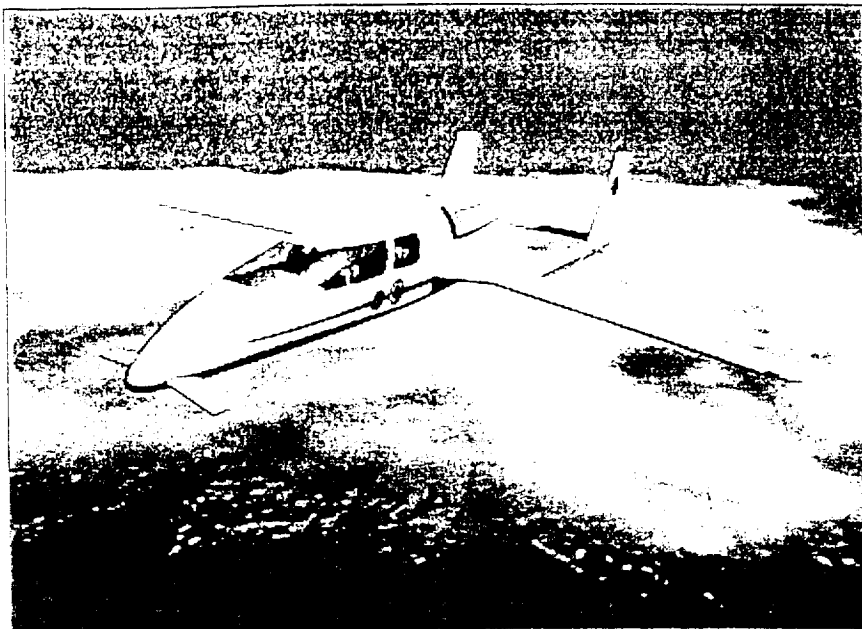
There has been some preliminary thought given to how the Competition can be revised to embrace the newly funded Small Aircraft Transportation System (SATS) program. Goals for the 2000-2001 year were expanded to embrace SATS goals. The project manager, Mary Sandy, plans to meet with Jim Burley in the near future to discuss a revised competition, which would have increased SATS focus.

### **Deliverables**

Hard copies of the 1999-2000 and 2000-2001 Competition Guidelines are attached. Note that the 2000-2001 Guidelines were distributed electronically and in hard copy only by special request. One zip disk version of the 2000-2001 Guidelines is also

provided. Hard Copies of the press releases for the announcement of the winners of both award categories are attached.

# National General Aviation Design Competition Guidelines



## 2000-2001 Academic Year



The National Aeronautics and Space Administration (NASA), the Federal Aviation Administration (FAA) and the Air Force Research Laboratory are sponsoring a National General Aviation Design Competition for students at U.S. aeronautical and engineering universities for the 2000-2001 academic year. The competition challenges individuals and teams of undergraduates and/or graduate students, working with faculty advisors, to address design challenges for general aviation aircraft.

Now in its seventh year, the competition seeks to increase the involvement of the academic community in the revitalization of the U.S. general aviation industry while providing real-world design and development experiences for students. It allows university students to participate in a national effort to revitalize the nation's general aviation industry and to help provide small aircraft transportation access to more

suburban, rural and remote communities, while raising student awareness of the value of general aviation for business and personal use, and its economic relevance. Faculty and student participants have indicated that the open-ended design challenges offered by the competition have provided the basis for quality educational experiences.

For this year's *Innovative Design* competition, individual students or teams are invited to submit paper design projects of systems, subsystems, components or complete airframes that address general aviation revitalization goals. Four cash awards are offered in this category, including a special award for a design which includes Air Force-developed technologies.

All design packages will be reviewed by a panel of industry, university and government experts and written feedback will be provided to the participating individuals/teams.



## ***Advanced General Aviation Transport Experiments (AGATE) Consortium***

### **Goal**

***To create the basis  
for a small aircraft  
transportation system  
and revitalize U.S.  
general aviation through  
development and  
deployment of advanced  
technologies in new  
designs and retrofit  
products.***

### **Members**

***Government, industry,  
and universities in  
cost-sharing partnerships***

### **Schedule**

***1994 to 2001***

### **Products**

***Engineering design guidelines  
for "best practices"***

***Industry standards for  
aircraft, training and  
infrastructure***

***FAA certification methods***

General Aviation (GA) includes all flight operations except commercial airlines and military. The 206,530 GA aircraft in service account for 59 percent of all U.S. flight hours and 77 percent of all departures in the United States. During its peak in 1978, U.S. manufacturers delivered over 14,000 new GA aircraft. Between 1979 and 1994, production dropped to 444 new aircraft per year. Today's GA market is showing a steady recovery with more than 2,504 new aircraft shipped during 1999.

With the start of the GA industry revitalization, universities have begun to recognize general aviation as an area for teaching and research. The government sponsors and their partners developed this competition to create this trend and to integrally involve faculty and students in national efforts to revitalize this important sector of aviation. This competition is an example of the type of new partnerships NASA is forming with academia to capture the bold initiative, innovation, talent and enthusiasm present in our Nation's academic community. NASA and the FAA have shown that this kind of competition serves to stimulate breakthroughs in technology and their application in the GA market.

The revitalization initiative is concerned, in part, with how to make general aviation more appealing for business as well as personal use. Revitalization efforts are making general aviation flight easier and more convenient. Improvements in air traffic control accessibility, as well as improved safety, comfort, reliability, dependability and performance are needed to raise user satisfaction. State-of-the-art technologies need to be applied to training and certification to make these goals a reality.

The average general aviation aircraft is nearly 30 years old and incorporates technology which is generally outdated. Current flight deck technologies range from the 1950's to the 1990's; piston propulsion technologies are more than 40 years old. Revitalization efforts encourage newer, more efficient, and user friendly technologies.

Among the more recent technologies which can be harnessed in revitalization efforts are new air traffic control and navigation tools, such as digital datalink and satellite navigation. New computer and display technologies, and new materials and composites processes are just a few of the existing technologies which can be applied to general aviation revitalization.

The revitalization initiative seeks to bring about increased use of general aviation in the U.S. which will, in turn, increase the volume of aviation production. Its success will have a vital and positive economic impact. Revitalization goals include:

- ➔ Expanding the Nation's economy to "off airways" communities;
- ➔ Increasing efficient utilization of the Nation's airspace;
- ➔ Creating world-wide demand for new, U.S.-built, "owner-operated" small business and personal aircraft; and,
- ➔ Creating jobs in airframe, engine, avionics, airport, and training industries.

A number of key engineering objectives (*see page 5*) have been established for the revitalization effort. Design teams should incorporate these objectives into their selection of design challenge(s) and their approach.

## Innovative Design Category KEY DATES

***Letter of Intent  
due no later than  
January 31, 2001***

***Design Submittal  
by May 7, 2001***

***Awards Ceremony  
August 2001***

U.S. colleges with at least four-year accredited engineering programs may compete. It is anticipated that this project will be undertaken as part of a formal undergraduate or graduate engineering course. Student professional societies may also participate in the competition, either independently or as a partner to an academic course effort. All design projects must be developed under the guidance of a university faculty advisor. Universities are encouraged, but not required, to take a multi-departmental approach and/or team with other academic organizations. Individual students/teams may choose to consult directly with industry representatives but are not required to do so.

For the successful revitalization of General Aviation, short term applications of AGATE technologies are needed. To support revitalization goals, successful designs should focus on technologies with most immediate and cost effective impact. Designs for systems or subsystems with retrofit applications are encouraged; however, whole aircraft designs will be considered. Designs will be primarily judged on their potential impact on the marketplace. Emphasis will be on affordable technologies, innovation and increased utility in both retrofit products and new aircraft. (See page 4 for design submission requirements.)

Entries should address design challenges in one or more of the following six technical areas:

- ♦ Integrated Cockpit Systems
- ♦ Propulsion, Noise and Emissions
- ♦ Integrated Design and Manufacturing
- ♦ Aerodynamics
- ♦ Operating Infrastructure
- ♦ Unconventional Designs  
Such as Roadable Aircraft

Individual students/teams are encouraged to consider more than one of the technology areas in their design package. It is desirable that interfaces with other systems be addressed. For example, if an operations concept is developed for an ice protection system, additional credit will be given if the design also considers the interaction with a cockpit weather system for graphical display for forecasting icing conditions and/or the design of an operational interface for the pilot. Retrofit options for existing aircraft offer great potential for meeting revitalization goals. Some areas where innovative designs with near-term applications are desired include, but certainly are not limited to:

- ♦ Affordable collision avoidance systems
- ♦ Situational awareness aids
- ♦ Single lever power control systems
- ♦ User friendly, effective, low fuel warning systems
- ♦ Effective alarm and warning management options
- ♦ Improved exterior lighting

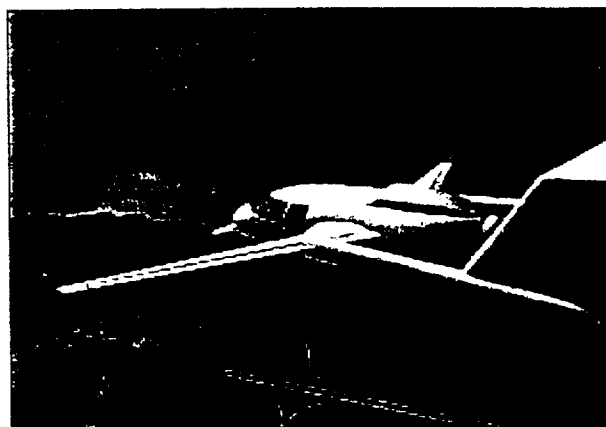
For the purposes of the Competition, general aviation aircraft are defined as fixed-wing, single-engine, single-pilot aircraft for 2-6 passengers, turbine or piston. The performance specifications are 150-400 kts with a range of 800-1,000 miles. All entries should apply to this category or aircraft.

In addition to first, second and third place awards, the Air Force Research Laboratory is offering an award for the best use of Air Force-developed technologies. The Competition Coordinator (see page 5) can assist teams with making connections to appropriate Air Force, NASA, or FAA contacts as needed.

## LETTER OF INTENT

A letter of intent to participate in the *Innovative Design* category must be submitted by the faculty advisor. The letter of intent should provide full contact information for the advisor (including fax and e-mail if available) as well as a general description of how the design package will be approached. Specific course involvement should be noted, as well as that of student professional societies and industry or other participants.

Letters must be received no later than January 31, 2001; however, it is in the individual's/team's interest to submit a letter of intent as early as possible. Individuals providing letters of intent will receive additional general aviation background material which will be helpful in the design process, as well as additional information on evaluation criteria and any other competition updates as they become available.





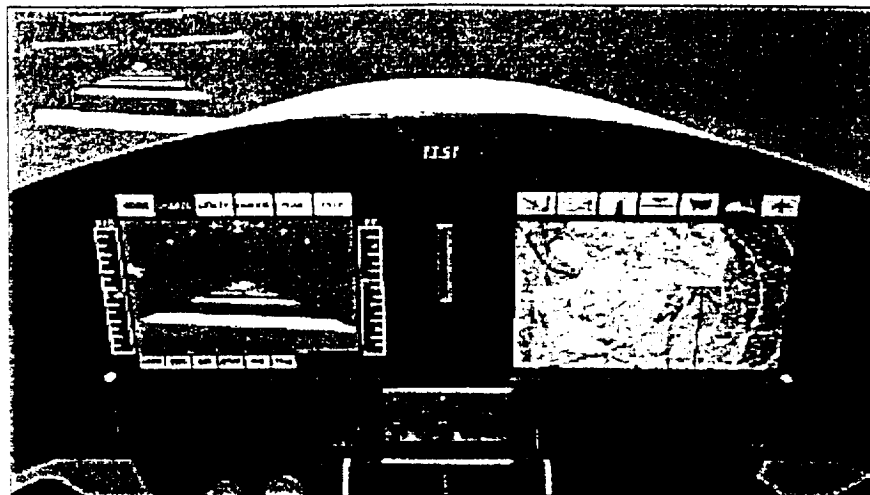
## DESIGN PACKAGE

Ten sets of the entire design package must be received by the Competition Coordinator no later than May 7, 2001.

Reviewable sections listed below are subject to a total page limit of 40 double spaced pages in 12-point type. For evaluation purposes, reviewers will focus on the reviewable sections of the design proposal including required appendices, but may reference Appendix E (*optional*) at their discretion. The seven sections and required appendices should be readily identifiable.

*Reviewable Sections of the Design Proposal (40 page limit):*

1. Executive Summary.
2. Background on the recent history and status of general aviation in the U.S. This section should broadly address issues relating to revitalization and demonstrate that the team has a clear understanding of the issues.
3. A concise statement of the design challenge(s) you have chosen to address and how these design challenges relate to U.S. general aviation revitalization goals.
4. Description of the team's systems engineering approach to the problem. This section should include a description of the team and its overall approach to the problem.
5. A description of how each of the technical areas is addressed in drawings, mockups, computer codes, etc., as appropriate to provide evidence of a thorough design process.
6. Description of the projected impacts of the team's design with a thorough discussion of how it meets general aviation revitalization goals. This section should address the commercial potential for the design, including a description of processes



that would need to be undertaken to bring the design to the product stage. Emphasis should be on increased affordability and utility.

7. Discussion of lessons learned from the design process, including a critical analysis of design flaws identified during the process.

Appendices A-D are required, but not included in the 40-page limit.

- A. List of complete contact information (use permanent addresses) for all advisors and team members. Include e-mail, fax and phone numbers.
- B. Description (approximately one page) of the university, college, professional society, industry, or other institutions involved in the project.
- C. Sign-off page for faculty advisor(s) and department chair(s).
- D. Evaluation of the educational experience provided by the project.

*The following appendix is optional:*

- E. Other support material: additional drawings, computer codes and other design elements as appropriate.

## AWARDS

An awards ceremony will be held in August 2001. Awards are anticipated as follows:

**\$5,000 Award**  
to the University Academic  
Department of First Place Winner

**\$3,000 First Place Award**  
to Design Team

**\$2,000 Second Place Award**  
to Design Team

**\$1,000 Third Place Award**  
to Design Team

### The Air Force Research Laboratory



is offering a \$3,000 team award for an aircraft design or aircraft subsystem design which meets all criteria for the National General

Aviation Design Competition and includes Air Force-developed technologies. Background on Air Force technologies is available at <http://www.afrl.af.mil> under Technology Transfer or through the AFRL Tech Connect Hotline at (800) 203-6451. The design package should identify the applicable Air Force technologies and document the source.

## INTEGRATED COCKPIT SYSTEMS

1. Reduce time and cost to learn and maintain all-weather safe operations skills by 50 percent (from current level of >1000 hours).
  - Achieve integration of weather, navigation (moving map), terrain/obstacle database, traffic situation, and wake vortex information into one multi function display.
  - Achieve integration of simplified flight controls with flight guidance displays.
  - Develop integrated computer-based training systems that coordinate the use of both on-board and desktop computers and displays (including virtual reality).
2. Reduce dependence on ground controller voice communications for safe, random access, point-to-point navigation in future air traffic systems.
3. Implement situational awareness technologies and operating systems to reduce accidents and fatalities caused by weather (icing, low visibility, convective weather) as a primary factor.
  - Achieve integration of expert systems for flight training, planning, operations, propulsion system management decision aiding, icing avoid and exit decision aiding, and emergency decision-making.
4. Establish requirements for preferred, affordable datalink for GA usage.
5. Reduce cost of near all-weather flight systems by 50 to 80 percent.

## PROPULSION

1. Establish certifiable digital single-lever powerplant control systems.
  - Emphasis on reducing costs: extending time between overhauls, increasing fuel economy, and reducing direct operating costs.
  - Address safety by reducing pilot workload and increasing engine reliability.
2. Develop engine diagnostics and condition monitoring for greater safety, efficiency and lower cost.
  - Identify critical in-flight conditions, capture non-critical conditions for analysis/trending and pre/post-flight diagnostics.

- Emphasis on low-cost, high reliability, low incidence of false alarms, and reduced emissions through improved operational control.
3. Develop innovative propulsion design which incorporates alternate fuels, low emission and low noise technologies.

## INTEGRATED DESIGN & MANUFACTURING

1. Develop and validate low-cost manufacturing methods to reduce airframe and propeller cost and weight.
  - Achieve reduced cost of manufacture of airframe components by 25 to 40 percent.
2. Develop and validate Quality Control/Non Destructive Evaluation (NDE) methods to reduce airframe cost and weight, increase quality of production, and reduce cost of maintenance.
  - Achieve reduced dependence on manual inspections through in-process NDE quality control for composite manufacturing processes and thus reduce time and cost for composite structure design validation.
  - Develop low-cost inspection techniques for airframe structure.
3. Develop and validate advanced crash-worthiness concepts and design methods to reduce full-scale testing requirements for certification.
  - Achieve increased survivability through low-cost, energy absorbing structural design concepts and advanced restraint devices.

## AERODYNAMICS

1. Develop computer-driven configuration design optimization code and use to improve a current production aircraft.
2. Develop active noise reduction system for interior use in general aviation aircraft.
3. Design improved, single-flap high-lift system to reduce noise footprint in airport vicinity for both takeoff and landing phases of operation.
4. Develop technique to predict drag in both cruise and takeoff configuration to within 5% and apply to a production aircraft.

5. Develop technique to accurately predict aileron and elevator loads for large control surface deflections.
6. Design a method for protecting the leading edges of laminar-flow surfaces from aerodynamic contamination.
7. Reduce cost for design and manufacture of ice protection systems for laminar flow wings.
8. Reduce cost for design and manufacture of ice protection systems for horizontal tailplanes.
9. Develop unconventional designs, such as roadable aircraft, which consider break through technologies for affordable designs that could capture a mass market.

## OPERATING INFRASTRUCTURE

1. Reduce the operating complexity and costs for airspace and ground systems infrastructure equipment and procedures for both pilots and air traffic managers.
  - Achieve simplified situational awareness and decision-making between pilots and controllers for "free-flight" or "direct-flight" capabilities.
  - Develop design concepts for advanced Communication/Navigation/Surveillance (CNS) air and ground systems based on datalink and satellite navigation technologies to reduce reliance on ground-based radar and voice communications.
2. Establish means for increased utility of airports in advanced air traffic management ("free-flight") environment.
  - Achieve integration of commercial information systems (rental cars, accommodations, food services, operational services) with flight information (weather, traffic, procedures, facilities databases) systems for all general aviation airports.
  - Achieve low-cost implementation of all-weather operational CNS capabilities for airports and heliports without precision landing capabilities in current instrument landing systems.

COMPETITION COORDINATOR

*Virginia Space Grant Consortium*

Old Dominion University Peninsula Center  
2713-D Magruder Boulevard  
Hampton, VA 23666

Phone: (757) 865-0726

Fax: (757) 865-7965

msandy@odu.edu

<http://www.vsgc.odu.edu>

*Questions regarding the competition  
should be provided in writing. At the sponsors'  
discretion, queries and responses may be made  
available to all design teams on a periodic basis.*

# NewsRelease



National Aeronautics and  
Space Administration

Langley Research Center  
Hampton, Virginia 23681-0001

Michael Braukus  
Headquarters, Washington, DC  
(Phone: 202/358-1979)

Keith Henry  
Langley Research Center, Hampton, VA  
(Phone: 757/864-6120/880-2472)

Tony Molinaro  
FAA Great Lakes Region  
(Phone: 847/294-7427)

Embargoed For Release Until:  
July 29, 2000

Mary Sandy  
Virginia Space Grant  
Consortium  
(Phone: 757/865-0726)

RELEASE NO. 00-060

## NASA and FAA announce design competition winners

*Oshkosh, Wis.* NASA and the FAA today recognized teams of university students for their innovative designs by announcing the winners of the 1999-2000 National General Aviation Design Competition. Five awards to winning university teams were presented at a ceremony held at AirVenture2000, the Experimental Aircraft Association's Annual Convention and Fly-In at Oshkosh, Wis.

Now in its sixth year, the competition calls for individuals or teams of undergraduate and graduate students from U.S. engineering schools to participate in a major national effort to rebuild the U.S. general aviation sector. For the purpose of the contest, general aviation aircraft are defined as single or twin engine (turbine or piston), single-pilot, fixed-wing aircraft for 2 - 6 passengers. The competition seeks to raise student awareness of the importance of general aviation by having the student address design challenges for a small aircraft transportation system. NASA and the FAA hope to stimulate breakthroughs in technology and their application in the general aviation marketplace.

In addition to cash prizes, the teams also have the opportunity to present NASA Technical Forums at AirVenture.

The **first place award** was presented to a 28-student team from Virginia Tech, Blacksburg, Va. and its collaborating partner -- Loughborough University, Leicestershire, United Kingdom. The award provides a total of \$3,000 to Virginia Tech's design team members and a \$5,000 award to Virginia Tech's Department of Aerospace and Ocean Engineering.

The team, which dubbed its design *Pegasus*, undertook the challenge of designing an aircraft that would be "roadable" -- capable of both ground and air travel. The ability to switch from aircraft to car-like operation allows such a vehicle to effectively utilize small airports, while offering true door-to-door service. The team recognized that the cost to actually produce such an aircraft would exceed today's typical general aviation aircraft cost; however, the students believed the additional cost should readily be offset by the convenience of not having to have a car for ground transportation.

- more -

Designing an air/ground vehicle presented unique problems. The students recognized that design tradeoffs were needed in order to obtain good performance in the air and adequate performance on the road, since road use was anticipated to be occasional. The team had to meet safety and operational regulations for both aircraft and automobiles. For one thing, the wing had to be folded, retracted, or otherwise stored for road use. The need for a large wing area for flight, a small span for highway use, and low lift in car mode was addressed by the use of a telescoping wing.

Dr. James Marchman, Virginia Tech and Dr. Gary Page, Loughborough University, were the team's faculty advisors. Financial support from Virginia Tech's College of Engineering and The Boeing Company permitted the inclusion of students from Loughborough University, a major British research institution, as international collaborators in the design. The faculty advisors and student team members found that the international and interdisciplinary team design approach added great value to the educational experience and mirrored the kind of international partnerships typical in today's global marketplace.

**Second place honors** went to a seven-student team from Purdue University, West Lafayette, Ind., for the *Silairus 490*, a six-passenger, high-performance piston engine aircraft with an Air Cushion Landing System (ACLS) in lieu of traditional landing gear. The design offers the capability of surface independent takeoff and landing, permitting the vehicle to access off-airways communities thus shortening door-to-door travel time. The *Silairus 490* features a high-tech, electronically data-linked cockpit with a comfortable cabin that is adaptable for many client applications. Dr. William A. Crossley was the faculty advisor. The second place award provides a \$2000 prize to the student team. The Purdue team also won the Best Use of Air-Force-Developed Technology award for its incorporation of the ACLS developed by the United States Air Force. For this award, the team will share a \$3,000 prize from the Air Force.

The Purdue team also won the **Best Use of Air-Force-Developed Technology award** for its incorporation of the Air Cushion Landing System (ACLS) developed by the United States Air Force. For this award, the team will share a \$3,000 prize from the Air Force.

**Third place** was awarded to Pennsylvania State University, University Park, Pa. The team's design, called, *Alnighter*, is a modern, composite general aviation aircraft. The six-place, single-engine, propeller-driven vehicle has a conventional layout. It features sophisticated aerodynamics and advanced systems and avionics. The team's faculty advisor was Dr. Barnes McCormick. For third place, the ten-student team will share a \$1,000 prize. Penn State has the distinction of winning a place award in each year of the competition.

**The Best Retrofit Design Award** was presented to a four-student, University of Oklahoma, Norman, Okla., team for development of an innovative, multi-mode tuned exhaust system which offers noise reduction while improving the airplane's performance. The design was undertaken as a part of a larger aircraft design project to show how older aircraft can be retrofitted with more modern technologies for increased performance and safety. The work was done under the supervision of Dr. Karl Bergey, the student's faculty advisor. A \$500 award was presented to the student team by the award's sponsor -- the AOPA (Aircraft Owners and Pilots Association) Air Safety Foundation.

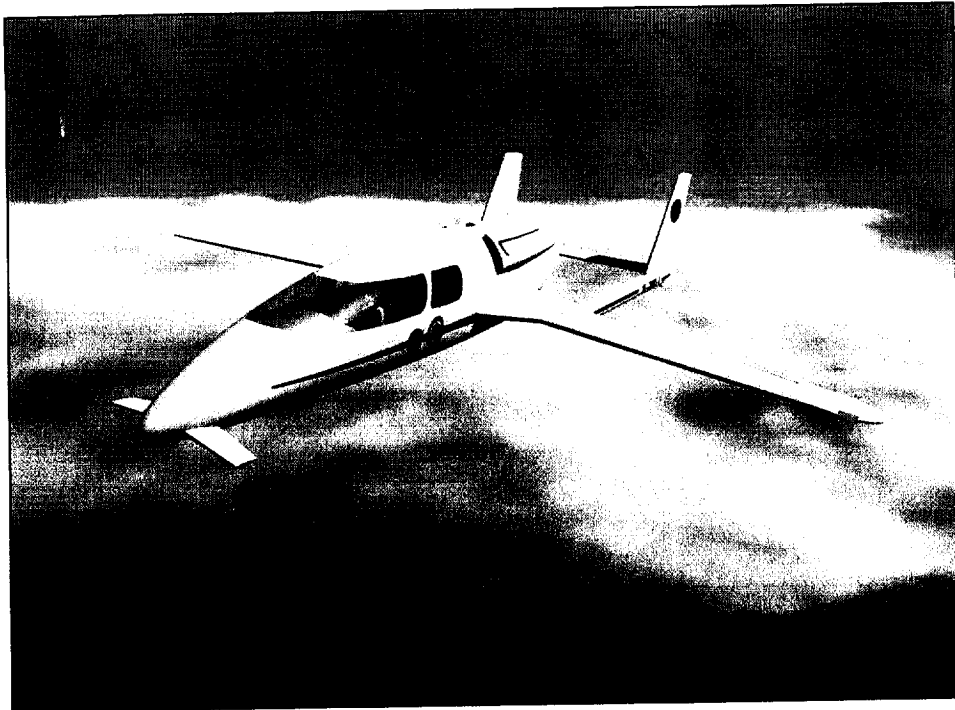
The competition is managed for NASA and the FAA by the Virginia Space Grant Consortium. Guidelines will soon be available for the seventh annual competition to be held during the 2000-2001 academic year. Individual or team submissions as well as designs ranging from components and subsystems to complete aircraft designs are encouraged. Guidelines can be requested at 757/865-0726 or msandy@odu.edu.

- end -

Note: Electronic images to illustrate this story are available by contacting Keith Henry at [h.k.henry@larc.nasa.gov](mailto:h.k.henry@larc.nasa.gov).

# National General Aviation Design Competition Guidelines

## 1999-2000 Academic Year



The National Aeronautics and Space Administration (NASA), the Federal Aviation Administration (FAA) and the Air Force Research Laboratory are sponsoring a National General Aviation Design Competition for students at U.S. aeronautical and engineering universities for the 1999-2000 academic year. The competition challenges individuals and teams of undergraduates and/or graduate students, working with faculty advisors, to address design challenges for general aviation aircraft.

Now in its sixth year, the competition seeks to increase the involvement of the academic community in the revitalization of the U.S. general aviation industry while providing real-world design and development experiences for students. It allows university students to participate in a major national effort to rebuild the U.S. general aviation sector while raising student awareness of the value of general aviation for business and personal use, and its economic relevance. Faculty and student participants have indicated that the open-ended design challenges offered by the competition have provided the basis for quality educational experiences.

The competition is divided into two categories, each with separate guidelines and time lines. The first is the *Innovative Design Category* (see pages 3-4), under which individual students or student teams submit paper design projects of systems, subsystems, components or complete airframes to address general aviation revitalization goals. Five cash awards are offered in this category, including special awards for product designs which are readily retrofitable to existing aircraft and those which make innovative use of Air Force-developed technologies. The second category, *Design It, Build It, Fly It* (see page 5), allows individual students or student teams to take well-developed design projects to a proof of concept or demonstration stage. The award for this category includes a cash development grant and the opportunity to demonstrate the concept at the Experimental Aircraft Association's (EAA) *AirVenture* held in Oshkosh, Wisconsin.

All design packages will be reviewed by a panel of industry, university and government experts and written feedback will be provided to the participating teams.



## *Advanced General Aviation Transport Experiments (AGATE) Consortium*

### Goal

*To create the basis  
for a small aircraft  
transportation system  
and revitalize U.S.  
general aviation through  
development and  
deployment of advanced  
technologies in new  
designs and retrofit  
products.*

### Members

*Government, industry,  
and universities in  
cost-sharing partnerships*

### Schedule

*1994 to 2001*

### Products

*Engineering design guidelines  
for "best practices"*

*Industry standards for  
aircraft, training and  
infrastructure*

*FAA certification methods*

General Aviation (GA) includes all flight operations except commercial airlines and military. The 192,000 GA aircraft in service account for 58 percent of all U.S. flight hours, 33 percent of all miles and 76 percent of all departures in the United States. During its peak in 1978, U.S. manufacturers delivered nearly 18,000 new GA aircraft. Between 1979 and 1994, production dropped below 1000 new aircraft per year. Today's GA market is showing a steady recovery with more than 2,200 new aircraft shipped during 1998.

With the start of the GA industry revitalization, universities have begun to recognize general aviation as an area for teaching and research. The government sponsors and their partners developed this competition to create this trend and to integrally involve faculty and students in national efforts to revitalize this important sector of aviation. This competition is an example of the type of new partnerships NASA is forming with academia to capture the bold initiative, innovation, talent and enthusiasm present in our Nation's academic community. NASA and the FAA have shown that this kind of competition serves to stimulate breakthroughs in technology and their application in the GA market.

The revitalization initiative is concerned, in part, with how to make general aviation more appealing for business as well as personal use. Revitalization efforts are making general aviation flight easier and more convenient. Improvements in air traffic control accessibility, as well as improved safety, comfort, reliability, dependability and performance are needed to raise user satisfaction. State-of-the-art technologies need to be applied to training and certification to make these goals a reality.

The average general aviation aircraft is 27 years old and incorporates technology which is generally outdated. Current flight deck technologies range from the

1950's to the 1990's; piston propulsion technologies are more than 40 years old. Revitalization efforts encourage newer, more efficient, and user friendly technologies.

Among the more recent technologies which can be harnessed in revitalization efforts are new air traffic control and navigation tools, such as digital datalink and satellite navigation. New computer and display technologies, and new materials and composites processes are just a few of the existing technologies which can be applied to general aviation revitalization.

The revitalization initiative seeks to bring about increased use of general aviation in the U.S. which will, in turn, increase the volume of aviation production. Its success will have a vital and positive economic impact. Revitalization goals include:

- ➔ Expanding the Nation's economy to "off airways" communities;
- ➔ Increasing efficient utilization of the Nation's airspace;
- ➔ Creating world-wide demand for new, U.S.-built, "owner-operated" small business and personal aircraft; and,
- ➔ Creating jobs in airframe, engine, avionics, airport, and training industries.

A number of key engineering objectives (see page 6) have been established for the revitalization effort. Design teams should incorporate these objectives into their selection of design challenge(s) and their approach.

## **COMPETITION COORDINATOR**

***Virginia Space Grant Consortium***  
Old Dominion University Peninsula Center  
2713-D Magruder Boulevard  
Hampton, VA 23666  
Phone: (757) 865-0726  
Fax: (757) 865-7965  
E-Mail: msandy@odu.edu

*Questions regarding the competition should be provided in writing. At the sponsors' discretion, queries and responses may be made available to all design teams on a periodic basis.*

## Innovative Design Category KEY DATES

*Letter of Intent  
due no later than  
January 31, 2000*

*Design Submittal  
by May 2, 2000*

*Awards Ceremony  
August 2000*

U.S. colleges with at least four-year accredited engineering programs may compete. It is anticipated that this project will be undertaken as part of a formal undergraduate or graduate engineering course. Student professional societies may also participate in the competition, either independently or as a partner to an academic course effort. All design projects must be developed under the guidance of a university faculty advisor. Universities are encouraged, but not required, to take a multi-departmental approach and/or team with other academic organizations. Teams may choose to consult directly with industry representatives but are not required to do so.

For the purposes of the competition, general aviation aircraft are defined as fixed-wing, single-engine, single-pilot aircraft for 2-6 passengers, turbine or piston. The performance specifications are 150-400 kts with a range of 800-1,000 miles.

For the successful revitalization of General Aviation, short term applications of AGATE technologies are needed. To support revitalization goals, successful designs should focus on technologies with most immediate and cost effective impact. Designs for systems or subsystems with retrofit applications are encouraged; however, whole aircraft designs will be considered. Designs will

be primarily judged on their potential impact on the marketplace. Emphasis will be on affordable technologies and increased utility in both retrofit and new aircraft. See page 4 for design submission requirements.

Teams should address design challenges in one or more of the following six technical areas:

- ◆ Integrated Cockpit Systems
- ◆ Propulsion, Noise and Emissions
- ◆ Integrated Design and Manufacturing
- ◆ Aerodynamics
- ◆ Operating Infrastructure
- ◆ Unconventional Designs  
Such as Roadable Aircraft

Teams are encouraged to consider more than one of the technology areas in their design package. It is desirable that interfaces with other systems be addressed. For example, if an operations concept is developed for an ice protection system, additional credit will be given if the design also considers the interaction with a cockpit weather system for graphical display for forecasting icing conditions and/or the design of an operational interface for the pilot. Retrofit options for existing aircraft offer great potential for meeting revitalization goals. Some areas where innovative designs with near-term applications are desired include, but certainly are not limited to:

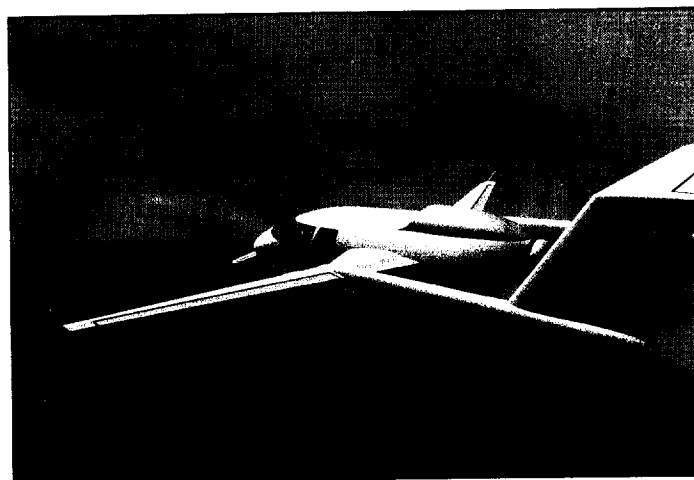
- ◆ Affordable collision avoidance systems
- ◆ Situational awareness aids
- ◆ Single lever power control systems
- ◆ User friendly, effective, low fuel warning systems
- ◆ Effective alarm and warning management options
- ◆ Improved exterior lighting

Two additional sponsored awards are offered in this year's competition. The AOPA Air Safety Foundation is sponsoring an award for the best retrofit design and the Air Force Research Laboratory is offering an award for the best use of Air Force-developed technologies. The Competition Coordinator can assist teams with making connections to appropriate Air Force, NASA, or FAA contacts as needed.

## LETTER OF INTENT

A letter of intent to participate in the *Innovative Design* category must be submitted by the faculty advisor. The letter of intent should provide full contact information for the advisor (including fax and e-mail if available) as well as a general description of how the design package will be approached. Specific course involvement should be noted, as well as that of student professional societies and industry or other participants.

Letters must be received no later than January 31, 2000; however, it is in the team's interest to submit a letter of intent as early as possible. Individuals providing letters of intent will receive additional general aviation background material which will be helpful in the design process, as well as additional information on evaluation criteria and any other competition updates as they become available.





## DESIGN PACKAGE

Ten sets of the entire design package must be received by the Competition Coordinator no later than May 2, 2000.

Reviewable sections listed below are subject to a total page limit of 40 double spaced pages in 12-point type. For evaluation purposes, reviewers will focus on the main body of the design proposal, but will reference the required appendices at their discretion. The six sections and required appendices should be readily identifiable.

### *Main Body of the Design Proposal:*

1. Executive Summary.
2. Background on the recent history and status of general aviation in the U.S. This section should broadly address issues relating to revitalization and demonstrate that the team has a clear understanding of the issues.
3. A concise statement of the design challenge(s) you have chosen to address and how these design challenges relate to U.S. general aviation revitalization goals.
4. Description of the team's systems engineering approach to the problem. This section should include a description of the team and its overall approach to the problem.
5. A description of how each of the technical areas is addressed in drawings, mockups, computer codes, etc., as appropriate to provide evidence of a thorough design process.
6. Description of the projected impacts of the team's design with a thorough discussion of how it meets general aviation revitalization goals. This section should address the commercial potential for the design, including a description of processes that would need to be undertaken to bring the design to the product stage. Emphasis should be on increased affordability and utility.

Appendices A-D are required, but not included in the 40-page limit.

- A. List of complete contact information (use permanent addresses) for all advisors and team members. Include e-mail, fax and phone numbers.
- B. Description (approximately one page) of the university, college, professional society, industry, or other institutions involved in the project.
- C. Sign-off page for faculty advisor(s) and department chair(s).
- D. Evaluation of the educational experience provided by the project.

*The following appendix is optional:*

- E. Other support material: additional drawings, computer codes and other design elements as appropriate.

## AWARDS

An awards ceremony will be held in August 2000. Awards are anticipated as follows:

**\$ 5,000 Award**  
to the University Academic  
Department of First Place Winner

**\$ 3,000 First Place Award**  
to Design Team

**\$ 2,000 Second Place Award**  
to Design Team

**\$ 1,000 Third Place Award**  
to Design Team

## ADDITIONAL SPONSORED AWARDS

### The Air Force Research Laboratory



is offering a \$3,000 team award for an aircraft design or aircraft subsystem design which meets all criteria for the National

General Aviation Design Competition and includes Air Force-developed technologies. Background on Air Force technologies is available at <http://www.afrl.af.mil> under Technology Transfer or through the AFRL Tech Connect Hotline at (800) 203-6451. The design package should identify the applicable Air Force technologies and document the source.

### The AOPA Air Safety Foundation

is providing a Best Retrofit Potential Award of \$500 to a student design team.

This award will be given for the best technological innovation that can be readily adapted to existing aircraft and offer a cost effective, near-term solution to technology upgrades. Special consideration will be given to the practicality of the design, including cost and ease of implementation within the existing fleet.



## Design It, Build It, Fly It Category

### KEY DATES

*Proposals due  
February 4, 2000*

*Winning Project(s)  
due by May 31, 2001*

*Winning Team(s)  
present at Airventure  
Summer 2001*

The *Design It, Build It, Fly It* category encourages students to take design concepts to a higher level “flight proof-of-concept or flight concept demonstration phase”.

This competition category is open to proposals that can demonstrate completion of the design phase of a concept with high relevance for General Aviation revitalization goals (see page 6). Such concept flight demonstrations might include, but are not limited to, prototype flight testing, in-flight simulation, in-flight software demonstrations, radio control models, and other proof of concept flight testing as appropriate. Proposals need to demonstrate a thorough design phase and applicability to AGATE engineering goals and objectives. This competition category fosters the development of viable concepts while continuing to meet the educational objectives of the National General Aviation Design Competition. **NOTE:** Proposals do NOT have to be derived from previous National General Aviation Design Competition submissions.

U.S. universities with at least a four-year accredited engineering program may participate in this category of the competition. Student teams or individuals under the guidance of faculty members should submit proposals, to include budget requirements, for seed funding. The total award pool is \$10,000. Funding will be provided to the winning proposal(s) at the beginning of the build phase by the government sponsors of the competition. The proposal should include a design summary, plans for the demonstration phase, timeline, and budget for the project. The proposal must include measurable progress points, as well as a plan for providing timely updates to the sponsors. Ties to GA revitalization goals must be presented. An appropriate aviation safety review process is required. Matching contributions from industry are encouraged and should be delineated in the proposal and explained in a budget narrative. Universities are encouraged to involve industry, EAA

chapters, and other appropriate aviation organizations. These groups might provide matching contributions, either cash or in-kind. The greatest contributions from such alliances can come from access to experts and exposure to industry culture/climate and role models for students. The practical knowledge and enthusiasm of EAA chapter members would be an asset to participants. The EAA Technical Counselors and Flight Advisors could participate by providing consultation in flight test planning and implementation. Participation by AGATE industry experts is also encouraged. A list of AGATE contacts is provided at: <http://agate.larc.nasa.gov>. Proposers needing assistance in connecting with the EAA, AGATE industries or contacts at other sponsoring organizations should contact the Competition Coordinator.

The competition particularly welcomes component design challenges. A few examples follow, but are only offered to stimulate thinking on the part of proposers:

- ➔ concepts that are retrofitable to existing aircraft
- ➔ angle of attack sensors and indicators
- ➔ new fuel quantity sensing systems
- ➔ single or multi channel stabilization systems
- ➔ new types of sensors for aircraft propulsion systems
- ➔ altitude hold systems and indicators
- ➔ electro-mechanical trim actuators
- ➔ crash survivable seats

The possibility for flight testing on the EAA's GlaStar aircraft can be explored for appropriate proposals. The GlaStar is a two-place high-wing aircraft with conventional aluminum wings. It has a composite fuselage covering a steel tube framed cockpit and is powered by a Lycoming engine. The aircraft is equipped with reconfigurable electronics capability and can accommodate a variety of flight test equipment. This venue should be discussed prior to proposal submission with the Competition's Coordinator.

Proposals must include the following:

- ◆ an executive summary;
- ◆ design overview with support documentation;
- ◆ plans for the development and demonstration phase, including how student teams/or individuals will approach this phase;
- ◆ flight safety review process;
- ◆ timeline to comply with award requirements;
- ◆ plans for development and peer review of the technical report;
- ◆ budget with narrative, including travel costs to *AirVenture*;

- ◆ sign-off page for faculty advisor(s) and department chair(s);
- ◆ letter of institutional commitment to the project signed by the individual(s) authorized to make sponsored program commitments for the submitting institution(s); and
- ◆ letters of commitment from industry or other partners for matching contributions.

***Ten sets of the entire proposal package must be received by the Competition Coordinator no later than February 4, 2000.***

Text should be double-spaced and 12-point type should be used. The narrative portion of the package may not exceed 40 pages in length and will be the primary focus for evaluators. Drawings, computer codes, video and other appropriate design elements may be included as attachments.

***Post Award Requirements:*** The time frame for building and testing of the winning proposal(s) has been expanded to a full academic year. The winning proposal(s) will be announced by March 17, 2000. The winning team(s) will then have until May 31, 2001 to complete their project. The winning team(s) must present, exhibit and provide demonstrations (as appropriate) at the EAA's *AirVenture* during summer 2001. Additionally the winning team(s) are required to submit a flight test technical report summarizing the results of the testing. Peer review of the technical report from the flight test community is required before publication and distribution. A safety review will be performed if required by the sponsors.

## AWARDS

### **\$ 10,000 Building Fund**

### **\$ 500 Student Prize**

Government sponsors anticipate making up to two awards from a total award pool of \$10,000, though the entire pool can be given to one winning proposal.



**The Experimental Aircraft Association** is sponsoring a \$500 per team student award. The EAA prize money will be awarded at *AirVenture* following delivery of the flight test technical report and exhibit and/or demonstration of the flight article. Information on the EAA and *AirVenture* is available at <http://www.eaa.org>.

## INTEGRATED COCKPIT SYSTEMS

1. Reduce time and cost to learn and maintain all-weather safe operations skills by 50 percent (from current level of >1000 hours).
  - Achieve integration of weather, navigation (moving map), terrain/obstacle database, traffic situation, and wake vortex information into one multi function display.
  - Achieve integration of simplified flight controls with flight guidance displays.
  - Develop integrated computer-based training systems that coordinate the use of both on-board and desktop computers and displays (including virtual reality).
2. Reduce dependence on ground controller voice communications for safe, random access, point-to-point navigation in future air traffic systems.
3. Implement situational awareness technologies and operating systems to reduce accidents and fatalities caused by weather (icing, low visibility, convective weather) as a primary factor.
  - Achieve integration of expert systems for flight training, planning, operations, propulsion system management decision aiding, icing avoid and exit decision aiding, and emergency decision-making.
4. Establish requirements for preferred, affordable datalink for GA usage.
5. Reduce cost of near all-weather flight systems by 50 to 80 percent.

## PROPULSION

1. Establish certifiable digital single-lever powerplant control systems.
  - Emphasis on reducing costs: extending time between overhauls, increasing fuel economy, and reducing direct operating costs.
  - Address safety by reducing pilot workload and increasing engine reliability.
2. Develop engine diagnostics and condition monitoring for greater safety, efficiency and lower cost.
  - Identify critical in-flight conditions, capture non-critical conditions for analysis/trending and pre/post-flight diagnostics.

- Emphasis on low-cost, high reliability, low incidence of false alarms, and reduced emissions through improved operational control.
3. Develop innovative propulsion design which incorporates alternate fuels, low emission and low noise technologies.

## INTEGRATED DESIGN & MANUFACTURING

1. Develop and validate low-cost manufacturing methods to reduce airframe and propeller cost and weight.
  - Achieve reduced cost of manufacture of airframe components by 25 to 40 percent.
2. Develop and validate Quality Control / Non Destructive Evaluation (NDE) methods to reduce airframe cost and weight, increase quality of production, and reduce cost of maintenance.
  - Achieve reduced dependence on manual inspections through in-process NDE quality control for composite manufacturing processes and thus reduce time and cost for composite structure design validation.
  - Develop low-cost inspection techniques for airframe structure.
3. Develop and validate advanced crash-worthiness concepts and design methods to reduce full-scale testing requirements for certification.
  - Achieve increased survivability through low-cost, energy absorbing structural design concepts and advanced restraint devices.

## AERODYNAMICS

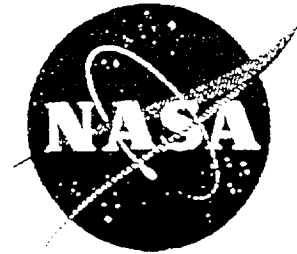
1. Develop computer-driven configuration design optimization code and use to improve a current production aircraft.
2. Develop active noise reduction system for interior use in general aviation aircraft.
3. Design improved, single-flap high-lift system to reduce noise footprint in airport vicinity for both takeoff and landing phases of operation.
4. Develop technique to predict drag in both cruise and takeoff configuration to within 5% and apply to a production aircraft.

5. Develop technique to accurately predict aileron and elevator loads for large control surface deflections.
6. Design a method for protecting the leading edges of laminar-flow surfaces from aerodynamic contamination.
7. Reduce cost for design and manufacture of ice protection systems for laminar flow wings.
8. Reduce cost for design and manufacture of ice protection systems for horizontal tailplanes.
9. Develop unconventional designs, such as roadable aircraft, which consider break through technologies for affordable designs that could capture a mass market.

## OPERATING INFRASTRUCTURE

1. Reduce the operating complexity and costs for airspace and ground systems infrastructure equipment and procedures for both pilots and air traffic managers.
  - Achieve simplified situational awareness and decision-making between pilots and controllers for "free-flight" or "direct-flight" capabilities.
  - Develop design concepts for advanced Communication / Navigation / Surveillance (CNS) air and ground systems based on datalink and satellite navigation technologies to reduce reliance on ground-based radar and voice communications.
2. Establish means for increased utility of airports in advanced air traffic management ("free-flight") environment.
  - Achieve integration of commercial information systems (rental cars, accommodations, food services, operational services) with flight information (weather, traffic, procedures, facilities databases) systems for all general aviation airports.
  - Achieve low-cost implementation of all-weather operational CNS capabilities for airports and heliports without precision landing capabilities in current instrument landing systems.

# NewsRelease



National Aeronautics and  
Space Administration

Langley Research Center  
Hampton, Virginia 23681-0001

Michael Braukus  
Headquarters, Washington, DC  
(Phone: 202/358-1979)

Embargoed For Release Until:  
July 29, 2000

Keith Henry  
Langley Research Center, Hampton, VA  
(Phone: 757/864-6120/880-2472)

Mary Sandy  
Virginia Space Grant  
Consortium  
(Phone: 757/865-0726)

Tony Molinaro  
FAA Great Lakes Region  
(Phone: 847/294-7427)

RELEASE NO. 00-060

## NASA and FAA announce design competition winners

*Oshkosh, Wis.* NASA and the FAA today recognized teams of university students for their innovative designs by announcing the winners of the 1999-2000 National General Aviation Design Competition. Five awards to winning university teams were presented at a ceremony held at AirVenture2000, the Experimental Aircraft Association's Annual Convention and Fly-In at Oshkosh, Wis.

Now in its sixth year, the competition calls for individuals or teams of undergraduate and graduate students from U.S. engineering schools to participate in a major national effort to rebuild the U.S. general aviation sector. For the purpose of the contest, general aviation aircraft are defined as single or twin engine (turbine or piston), single-pilot, fixed-wing aircraft for 2 - 6 passengers. The competition seeks to raise student awareness of the importance of general aviation by having the student address design challenges for a small aircraft transportation system. NASA and the FAA hope to stimulate breakthroughs in technology and their application in the general aviation marketplace.

In addition to cash prizes, the teams also have the opportunity to present NASA Technical Forums at AirVenture.

**The first place award** was presented to a 28-student team from Virginia Tech, Blacksburg, Va. and its collaborating partner -- Loughborough University, Leicestershire, United Kingdom. The award provides a total of \$3,000 to Virginia Tech's design team members and a \$5,000 award to Virginia Tech's Department of Aerospace and Ocean Engineering.

The team, which dubbed its design *Pegasus*, undertook the challenge of designing an aircraft that would be "roadable" -- capable of both ground and air travel. The ability to switch from aircraft to car-like operation allows such a vehicle to effectively utilize small airports, while offering true door-to-door service. The team recognized that the cost to actually produce such an aircraft would exceed today's typical general aviation aircraft cost; however, the students believed the additional cost should readily be offset by the convenience of not having to have a car for ground transportation.

- more -

Designing an air/ground vehicle presented unique problems. The students recognized that design tradeoffs were needed in order to obtain good performance in the air and adequate performance on the road, since road use was anticipated to be occasional. The team had to meet safety and operational regulations for both aircraft and automobiles. For one thing, the wing had to be folded, retracted, or otherwise stored for road use. The need for a large wing area for flight, a small span for highway use, and low lift in car mode was addressed by the use of a telescoping wing.

Dr. James Marchman, Virginia Tech and Dr. Gary Page, Loughborough University, were the team's faculty advisors. Financial support from Virginia Tech's College of Engineering and The Boeing Company permitted the inclusion of students from Loughborough University, a major British research institution, as international collaborators in the design. The faculty advisors and student team members found that the international and interdisciplinary team design approach added great value to the educational experience and mirrored the kind of international partnerships typical in today's global marketplace.

**Second place honors** went to a seven-student team from Purdue University, West Lafayette, Ind., for the *Silairus 490*, a six-passenger, high-performance piston engine aircraft with an Air Cushion Landing System (ACLS) in lieu of traditional landing gear. The design offers the capability of surface independent takeoff and landing, permitting the vehicle to access off-airways communities thus shortening door-to-door travel time. The *Silairus 490* features a high-tech, electronically data-linked cockpit with a comfortable cabin that is adaptable for many client applications. Dr. William A. Crossley was the faculty advisor. The second place award provides a \$2000 prize to the student team. The Purdue team also won the Best Use of Air-Force-Developed Technology award for its incorporation of the ACLS developed by the United States Air Force. For this award, the team will share a \$3,000 prize from the Air Force.

The Purdue team also won the **Best Use of Air-Force-Developed Technology award** for its incorporation of the Air Cushion Landing System (ACLS) developed by the United States Air Force. For this award, the team will share a \$3,000 prize from the Air Force.

**Third place** was awarded to Pennsylvania State University, University Park, Pa. The team's design, called, *Alnighter*, is a modern, composite general aviation aircraft. The six-place, single-engine, propeller-driven vehicle has a conventional layout. It features sophisticated aerodynamics and advanced systems and avionics. The team's faculty advisor was Dr. Barnes McCormick. For third place, the ten-student team will share a \$1,000 prize. Penn State has the distinction of winning a place award in each year of the competition.

**The Best Retrofit Design Award** was presented to a four-student, University of Oklahoma, Norman, Okla., team for development of an innovative, multi-mode tuned exhaust system which offers noise reduction while improving the airplane's performance. The design was undertaken as a part of a larger aircraft design project to show how older aircraft can be retrofitted with more modern technologies for increased performance and safety. The work was done under the supervision of Dr. Karl Bergey, the student's faculty advisor. A \$500 award was presented to the student team by the award's sponsor -- the AOPA (Aircraft Owners and Pilots Association) Air Safety Foundation.

The competition is managed for NASA and the FAA by the Virginia Space Grant Consortium. Guidelines will soon be available for the seventh annual competition to be held during the 2000-2001 academic year. Individual or team submissions as well as designs ranging from components and subsystems to complete aircraft designs are encouraged. Guidelines can be requested at 757/865-0726 or [msandy@odu.edu](mailto:msandy@odu.edu).

- end -

Note: Electronic images to illustrate this story are available by contacting Keith Henry at [h.k.henry@larc.nasa.gov](mailto:h.k.henry@larc.nasa.gov).

# NewsRelease



National Aeronautics and  
Space Administration

Langley Research Center  
Hampton, Virginia 23681-0001

Keith Henry  
Langley Research Center, Hampton, VA  
(Phone: 757/864-6120)

For Release: July 29, 2000

Mary Sandy  
Virginia Space Grant Consortium  
(Phone: 757/865-0726)

Jerri Culpepper  
University of Oklahoma  
(Phone: 405/325-1701)

RELEASE NO. 00-058

## University of Oklahoma Wins Design It, Build It, Fly It Competition

A group of student engineers from the University of Oklahoma in Norman, Ok. working to create safer, more crashworthy seating for General Aviation passengers has won the *Design It, Build It, Fly It* award of the National General Aviation Design Competition. The student team, working under the guidance of faculty advisor Karl Bergey, will receive a \$10,000 grant to take the team's highly innovative seat designs through a proof-of-concept phase. The students will also receive an award of \$500 from the Experimental Aircraft Association (EAA), the award co-sponsor, upon presentation of the final results of their work at the EAA's AirVenture 2001 in Oshkosh, Wis.

The National General Aviation Design Competition, which is sponsored by NASA and the Federal Aviation Administration, encourages university student teams to participate in a national effort to revitalize general aviation. This category allows students to take a well-evolved design to a proof-of-concept phase. The University of Oklahoma award is the second to be made in this category. An earlier version of the seat design won the *Design with Best Retrofit Potential* award in the 1999 General Aviation Design Competition, which was sponsored by the Aircraft Owners and Pilots Association (AOPA).

Senior aerospace engineering design students at the University of Oklahoma are designing and building a four-place high performance general aviation aircraft, the BAC S28R Cougar, that incorporates a number of innovative design features and complies with current FAA requirements for aircraft certification. Over a period of two years, 22 aerospace and mechanical engineering students have been involved in the project. The purpose of the project is to demonstrate the suitability of these features for incorporation into general aviation aircraft, either in new designs or through retrofit to the existing fleet.

The energy absorbing seat design is part of the full aircraft development. The goal for the team's seat design is to create a lightweight, low cost, energy-absorbing, crashworthy seat that would meet the lumbar loading requirements of federal aviation regulations. The seat design will help

- more -

dissipate excess energy and prevent lower back and pelvic injuries.

The team used a variety of static and dynamic tests to narrow the type of material that should be used. The goal is to design the seat such that the occupant loads would be dissipated in the seat pan rather than the seat frame itself. The seat pan is made of expanded carbon steel, which has been slit and expanded or drawn into an open mesh pattern in a single operation without loss of metal. This process creates a material that is stronger per pound and absorbs impact energy through plastic deformation. The resulting material looks much like a diamond-patterned chain link fence. Early tests using a tapered seat pan have indicated its capability to minimize loads on a passenger's spinal column.

Karl Bergey, faculty advisor, said, "The purpose of the program is to provide hands-on design and fabrication experience for the student aerospace engineers. In a computer-dominated educational system, the requirements for real world engineering judgement are often neglected. The COUGAR project supplies that linkage."

Oklahoma students will use the award to undertake additional testing to refine the design of the seat pan and to validate the results of their previous static and dynamic tests. Since the seat pan design is fairly well evolved, the design of the seat back will be the focus of analysis and testing for optimum configuration, design and strength.

The National General Aviation Design Competition is coordinated for NASA by the Virginia Space Grant Consortium. Copies of the guidelines for the 2000 - 2001 Academic Year Competition can be requested by calling 757/865-0726 or emailing msandy@odu.edu.